

by the fluid supply pump. The above explanation is made on the assumption that the viscosity of each of the fluid A and the fluid B does not change. However, even when viscosities of the fluid A and the fluid B change in the progress of a chemical reaction or solvent extraction, the position of the fluid boundary varies according to changes of  $d_A$  and  $d_B$  because a balance is maintained in Formula 7.

[0013] A second factor that the position of the fluid boundary is unstable and varies is caused by a wraparound phenomenon of fluid due to a difference of affinity between the inner wall of the fine channel and fluid to be supplied, as shown in FIG. 3(c). For example, when an aqueous phase 1 and an organic phase 2 are supplied into a fine channel made of glass as shown in FIG. 3(b), the aqueous phase flows toward a side of the inner wall of the channel so as to surround gradually an outer side of the organic phase as shown in FIG. 3(b) because the affinity of the aqueous phase to glass is higher than that of the organic phase. If the phases are branched at the branch portion of the fine channel in such state, the aqueous phase is mixed to the organic phase and vice versa.

[0014] Because of the above-mentioned factors, it is not easy to form stably the fluid boundary 3 as shown in FIG. 2 in the fine channel. In particular, when fluid is supplied at a low flow rate to obtain a long stay time of fluid in the fine channel so that a chemical reaction time or a solvent extraction time in the fine channel can be prolonged, fluctuation in the fluid supply rate or a wraparound phenomenon of fluid is apt to occur.

[0015] In order to stabilize the fluid boundary of at least two kinds of fluid supplied to a fine channel, a fine channel structure is proposed wherein a guide-like portion 16 having a height of about 20% or less as much as the depth of a channel 17 is formed in a bottom surface 18 of the fine channel as shown in FIG. 5(a) (see, for instance, a patent document 1 (Japanese Unexamined Patent Publication No. 2002-1102) and a patent document 2 (WO96/12541), for example). The formation of such guide-like portion in the bottom surface of the fine channel can suppress to a certain extent the fluctuation of the position of the fluid boundary 3 shown in FIG. 3(a). However, it is impossible to suppress sufficiently the wraparound phenomenon 15 of fluid due to the difference of affinity between the inner wall of the fine channel and the fluid to be supplied, as shown in FIG. 3(b). Accordingly, it was very difficult to discharge at least two kinds of fluid separately without the mixing of fluid through outlet ports in the fine channel even though the fine channel having the guide-like portion in the bottom surface of the fine channel was used.

[0016] Namely, in the conventional technique, there was fluctuation in the position of the fluid boundary due to a change of the flow rate per unit time, which was caused by the fluid supply pump whereby a laminar flow could not be maintained, and a wraparound phenomena of fluid took place due to a difference of affinity between the inner wall of the fine channel and the fluid to be supplied. Accordingly, a kind of fluid was caused to be mixed with another kind of fluid to be discharged through an outlet port of the fine channel, and it is impossible to stop completely a chemical reaction or solvent extraction which is caused by the mutual contact of fluid in the fine channel at the branch portion of the fine channel. Further, in order to reuse the fluid supplied

once to the fine channel, it was necessary to separate a mixture comprising at least two kinds of fluid discharged from an outlet port. According to the conventional technique, however, it was difficult to realize easily the reuse of the fluid.

[0017] Further, as described before, when at least two kinds of fluid were passed through the fine channel, it was difficult to separate sufficiently without causing mixing between adjacent flows of fluid. Accordingly, a contact time of fluid, i.e., a mixing time and/or a time of chemical reaction, of the adjacent flows of fluid in the fine channel wherein the contact time of fluid is determined by a length of the fine channel and/or a flow rate of fluid, could not be determined only in the fine channel. Therefore, the mixing and/or the chemical reaction of fluid could not be stopped only in the fine channel whereby the mixing and/or the chemical reaction of fluid progressed even after the passing through the fine channel. For example, the production of a by-product by a consecutive reaction proceeded after the fluid was out of the fine channel to thereby cause a reduction of yield. Thus, the primary performance of the fine channel, i.e., the control of a consecutive reaction or suppression of a side reaction could not be obtained (see, for example, the above-referred non-patent document 1).

[0018] Further, since it was difficult to separate sufficiently at least two kinds of fluid without causing the mixing between adjacent flows of fluid after they were passed through the fine channel as described above, a contact time of fluid, i.e., a time of solvent extraction in which an extracted material in an extracting solvent is extracted into an extracting solvent, between adjacent flows of fluid in the fine channel, the contact time being determined by a length of the fine channel and/or a flow rate of fluid, could not be determined only in the fine channel. Therefore, the process of the solvent extraction could not be stopped in the fine channel whereby the solvent extraction proceeded even after at least two kinds of fluid had passed through the fine channel. For example, the mixing proportion of fluid varied at the outside of the fine channel, and it was impossible to conduct the solvent extraction keeping a predetermined volume ratio of the extracted solvent to the extracting solvent. Further, it was difficult to separate sufficiently the extracting solvent used for solvent extraction in the fine channel from the extracted solvent outside the fine channel. Here, the solvent extraction means the extraction of a material to be extracted in an extracting solvent into an extracting solvent as described above. In the present invention, however, it includes that a liquid phase comprising liquid is vaporized and the vaporized phase is brought into a gas phase comprising gas which is adjacent to the liquid phase.

[0019] Recently, there has been attempted a selectively permeating technique in which a substance in a kind of fluid is selectively collected through a film formed at a fluid boundary which is formed by passing at least two kinds of fluid flowing as laminar flows adjacently channel (see, for example, a non-patent document 2: "Formation of a partition film of copolymer in a microchannel", p. 11, preliminary papers of lecture by Yoshinori Shimizu et al. in the 3rd Chemical and Microsystem Society, published in 2001), or a technique of carrying a catalyst or an enzyme on said film to cause a catalytic reaction or an enzyme reaction (see, for example, a non-patent document 3: "Formation and appli-